



A Study of Jacques Burkhardt's Scientific Drawings of Western Pond Turtles (*Actinemys* spp.) in the Ernst Mayr Library of the Museum of Comparative Zoology (Harvard University)

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INTRODUCTION

Swiss scientific illustrator Jacques Burkhardt, best known for his role as naturalist Louis Agassiz's "personal artist," was a prolific artist whose work in the Ernst Mayr Library of the Museum of Comparative Zoology (MCZ) at Harvard University remained until recently largely unpublished. The Jacques Burkhardt Collection's 976 scientific drawings include watercolor and/or pencil drawings of invertebrate and vertebrate species, a good number of them fishes and turtles. Amongst the turtle illustrations are two watercolor drawings clearly identified as *Emys nigra*, which today could be one of two species under the Western Pond Turtle complex (*Actinemys* spp.). Herein, we revisit the life of Jacques Burkhardt; investigate Burkhardt's two *Emys nigra* drawings and an additional four as-yet unidentified drawings suspected to be Western Pond Turtles; compare them with preserved Western Pond Turtle specimens in the MCZ; identify matches between specimens and drawings; and provide an overall analysis of the three MCZ Western Pond Turtle specimens that we believe are the basis for five of Burkhardt's six *Actinemys* spp. drawings.

BIOGRAPHY OF JACQUES BURKHARDT

Jacques Burkhardt (November 8, 1808 – February 20, 1867¹) (Anonymous 1867, Britski and de Figueiredo 2023) (Fig. 1) was born in Hasle-bei-Burgdorf, a village in the Berne canton in Switzerland (Bénézit 2006). Although little is known about his childhood, Burkhardt studied painting and drawing in Munich and Rome (Marcou 1896, Bénézit 2006). During his "student days" in Munich, Burkhardt had become acquainted with the Swiss-American naturalist Jean Louis Rodolphe ("Louis") Agassiz (May 28, 1807 – December 14, 1873) (Lyman 1873, Marcou 1896, Tharp 1959) and by 1839 Burkhardt found himself among twelve scientific draftsman working under Agassiz's oversight in Neuchâtel, Switzerland (Manthorne 1989).

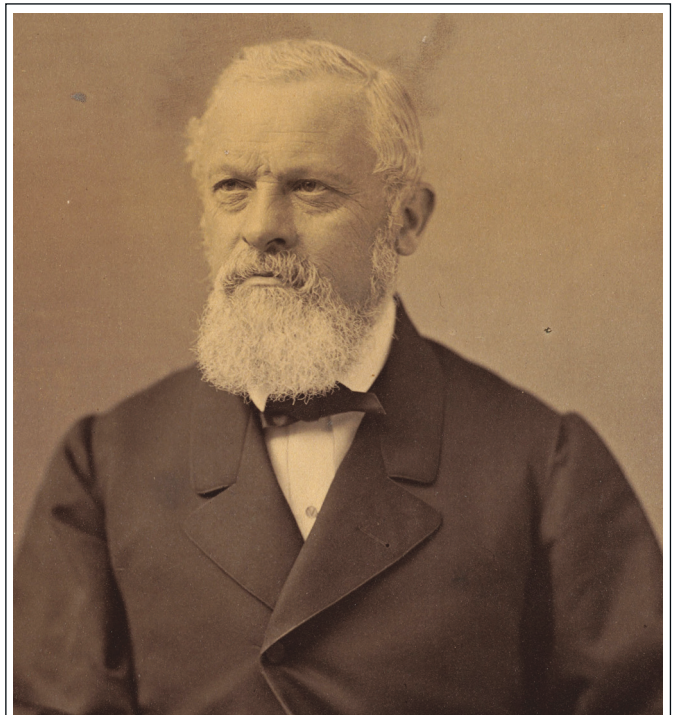


Fig. 1. Portrait of Jacques Burkhardt, ca. 1860 (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology).

As a young artist, Burkhardt was a purportedly unsuccessful painter. According to Tharp, Burkhardt "worked diligently, but nobody bought his pictures" (1959; p. 105).

Burkhardt, who was not an exact draughtsman, being skillful only in colouring the drawings after they had been made by others, led at Neuchâtel a precarious and unsettled life, and was unable to make both ends meet. Disappointed in his endeavour to become an artist of repute, Burkhardt enlisted in a sort of half-military, half colonial organization, created by the Belgian government, as a means of establishing a colony... in Guatemala. (Marcou 1896; p. 4)

After joining the expedition, the colonists were turned away and sent back to New York (Marcou 1896, Tharp 1959). There, Burkhardt found himself stranded, unable to speak English, painting landscapes on window shades and repairing old oil paintings. In 1847, after Burkhardt learned that Agassiz had recently arrived in New York on a lecture tour, the two were reunited (Marcou 1896).

Burkhardt... gladly called on him and told him his pathetic history, his attitude and appearance amply proving that life in the streets of New York under such conditions was a difficult one to endure. Agassiz, always open-handed and generous, received his old artist with great kindness, and offered him a home, on the single condition that he should draw his zoological specimens. The unfortunate artist was only too ready to accept any offer, or, more correctly, any arrangement, which promised a living; and with that lack of specific agreement which always characterized Agassiz's connection with his assistants, he resumed his position as draughtsman, and was brought by Agassiz to East Boston, on his return from New York, at the end of November, 1847. This haphazard association lasted until the death of Burkhardt, and is the only one, of all those formed in the same way, during the life of Agassiz, which remained undisturbed. (Marcou 1896; p. 5)

Having worked for Agassiz previously from 1839 until 1843, the two quickly rekindled their friendship. Burkhardt became a permanent member of the household, even after Agassiz's second marriage to Elizabeth Cabot Cary in 1850 (Marcou 1896). By one account, "Agassiz carried Burkhardt around with him like a camera" during his many visits to Charleston, South Carolina, to sketch local fish and crustaceans (Sanders and Anderson 1999; p. 66). More than just a colleague, Burkhardt became a dear friend, "a fixture in the Agassiz family" (Tharp 1959; p. 106). Elizabeth described Burkhardt as a "loyal friend and warm-hearted man, with a thread of humor running through his dry good sense, which made him a very amusing and attractive companion" (Agassiz 1885a; pp. 320–21).

Burkhardt was not Agassiz's first full-time live-in artist; Joseph Dinkel had previously filled that role for 18 years in Paris and Neuchâtel. While foreign to us today, Dinkel and Burkhardt's living arrangements—closely embedded in their employer's household—likely represent the vestiges of "semi-domestic arrangements, based on Old World assumptions of service and patronage" (Blum and Landry 1977).

In the United States under the employ of Agassiz, Burkhardt began drawing the "Agassiz Museum" (Manthorne 1989), Agassiz's growing collection of specimens that would eventually form the basis of Harvard University's Museum of Comparative Zoology (MCZ) in 1859. As the MCZ's mu-

seum artist, Burkhardt was responsible for illustrating a series of diagrams to accompany the public exhibits (Blum and Landry 1977). Burkhardt was also talented at drawing landscapes and architecture exemplified by his street scenes and landscape sketches of Rome, Italy, and watercolor landscape paintings of Brazil (MCZ n.d.). However, some of Burkhardt's most notable work includes turtle (and other species) drawings adapted on stone by lithographer Antoine Sonrel² (1813–1879) (Fig. 2) and published as part of Agassiz's four-volume³ *Contributions to the Natural History of the United States of America*, published between 1857 and 1862 (see Agassiz 1857a,b). In the introduction to the series, Agassiz recognizes Burkhardt's contributions thusly:

I have also caused innumerable drawings of these [turtle] specimens to be made by my tried friend, J. Burkhardt, representing their varieties of color and form, and their different attitudes. These drawings and sketches would fill over one hundred plates, and are too numerous to be published in this series; but I shall avail myself of every opportunity to publish them, in the style of Plates 26 and 27. (Agassiz 1857a; p. XV)

In response to a missive from Emperor Charles-Louis Napoléon Bonaparte (Napoleon III) (1808–1873) regarding the "acclimatization of several marine animals living in the American Atlantic" (Marcou 1896; p. 134), Agassiz sent Burkhardt to Europe in September, 1861 with a cargo consisting of live Quahog and steamer clams, scallops, mussels, and lobsters. From Boston to Liverpool, England, and then onward to Le Havre, France, only 200 live Quahog clams survived the journey (Marcou 1896). There, Burkhardt was presented to Emperor Napoleon at the Tuileries Palace (Marcou 1896) and found time to draw objects in European collections (Manthorne 1989).

From April 1865 to August 1866 Agassiz undertook the "Thayer Expedition" to explore and describe the biodiversity of Brazil with his wife and a dozen assistants. Burkhardt joined the expedition as Agassiz's official artist (Marcou 1896). During this expedition, despite a recurrence in mid-August 1865 of a longstanding illness aggravated by the hot climate (Agassiz and Agassiz 1867), Burkhardt produced anywhere from 458 (MCZ n.d) to more than 800 (Agassiz and Agassiz 1867) to as many as 1,100 (Agassiz 1885b) watercolors and/or pencil drawings of fishes, vertebrates, and invertebrates. Working in extreme conditions, whether on the deck of a boat or in a simple hut on the banks of the Amazon or plagued by mosquitoes, Burkhardt drew up to 20 fishes every day. Specimens were kept alive in a glass tank for days at a time to allow Burkhardt to observe their behavior and duplicate their natural colors. These on-site drawings were "drafts" sketched to inform the final illustrations, and often included Agassiz's and other expedition members' handwritten notes and comments (Britski and de Figueiredo 2023).

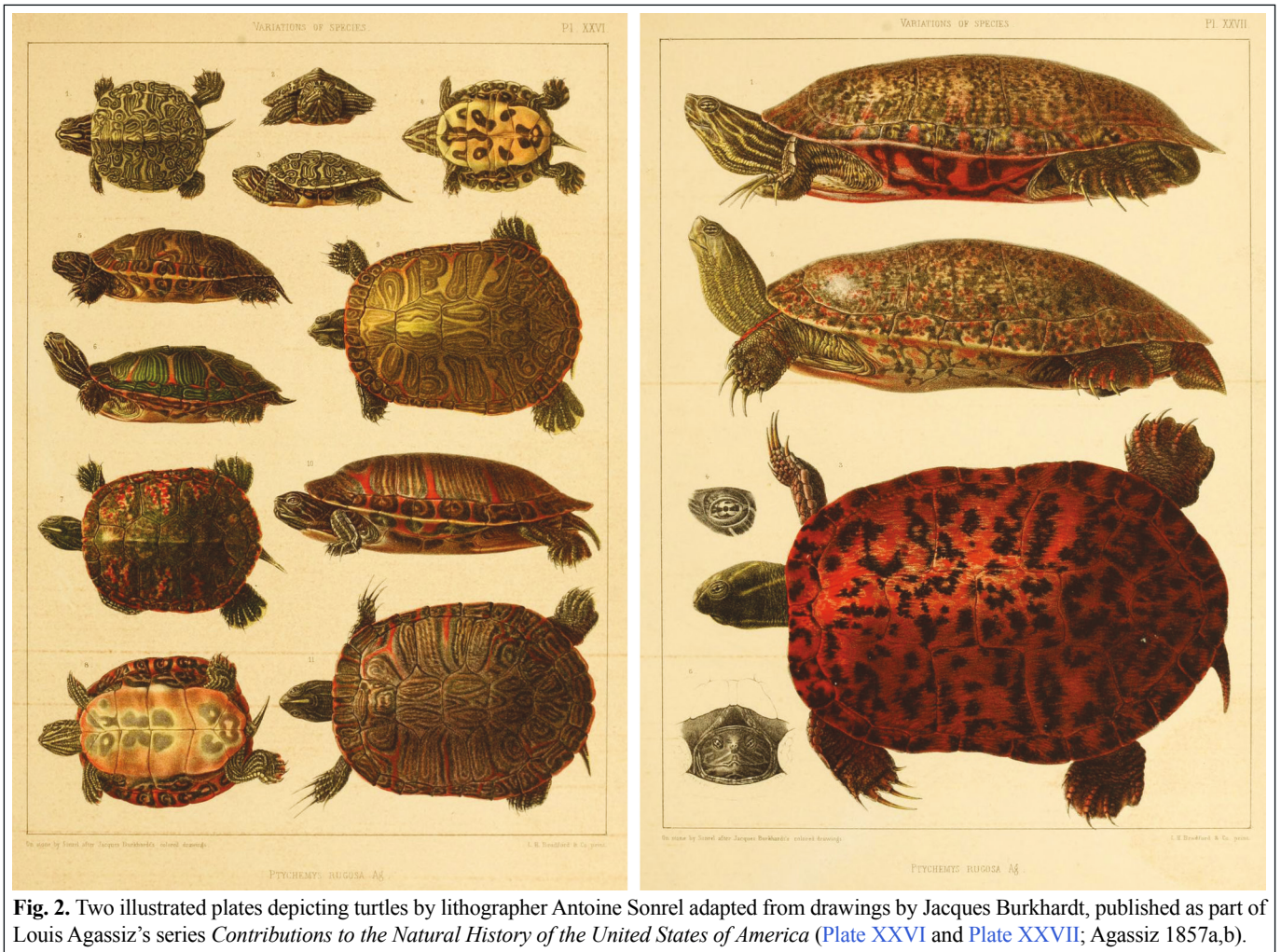


Fig. 2. Two illustrated plates depicting turtles by lithographer Antoine Sonrel adapted from drawings by Jacques Burkhardt, published as part of Louis Agassiz's series *Contributions to the Natural History of the United States of America* (Plate XXVI and Plate XXVII; Agassiz 1857a,b).

Although Burkhardt was sketching “draft” drawings to inform future watercolors (Britski and de Figueiredo 2023), his quick work was still detailed enough that the local Amazonian Manaós peoples had no trouble distinguishing the drawings:

His [= Agassiz's] studies have been the subject of great curiosity to the people about the sitio⁴; one or two were always hovering about to look at his work and to watch Mr. Burkhardt's drawing. They seemed to think it extraordinary that any one should care to take the portrait of a fish. The familiarity of these children of the forest with the natural objects about them — plants, birds, insects, fishes, etc. — is remarkable. They frequently ask to see the drawings ; and in turning over a pile containing several hundred colored sketches of fishes, they scarcely make a mistake, — even the children giving the name instantly, and often adding, “ *É filho d'este,* ” (it is the child of such an one,) thus distinguishing the young from the adult, and pointing out their relation. (Agassiz and Agassiz 1867; pp. 273-74)

Accurate though they may be, Burkhardt's Brazilian fishes watercolors are at times “pencil sketches, some consisting of simple outlines, sometimes very incipient”; in some cases, fins, eyes or pupils are missing altogether or distorted, “probably due to the speed at which they were done” (Britski and de Figueiredo 2023; pp. 31, 35).

Among the Brazilian fishes drawings (and among the turtle drawings), Burkhardt often prepared several drawings of the same species based on specimens whose colors or markings varied (Britski and de Figueiredo 2023). This practice was no doubt spurred by Agassiz's ongoing struggle to understand the individual variety exhibited by an individual organism vs their respective species (Agassiz 1857a, Winsor 1979).

At some point between February 4 and March 9, 1866⁵, Burkhardt left the expedition prematurely due to his illness and returned to the United States. Back in Boston, he continued to decline (Blum and Landry 1977). Even as his health worsened, Burkhardt commenced work on the final illustrations for Agassiz's monograph on Brazilian fishes (Britski and de Figueiredo 2023). On February 20, 1867, Burkhardt died in

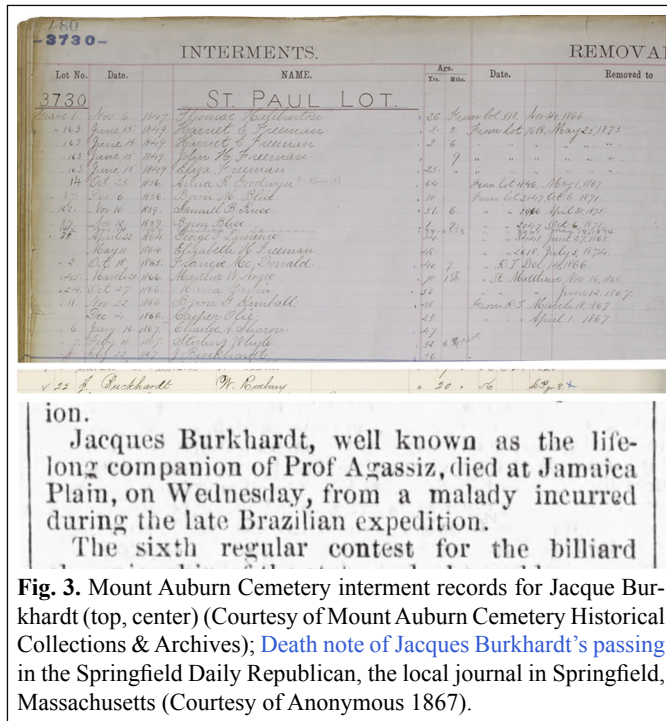


Fig. 3. Mount Auburn Cemetery interment records for Jacques Burkhardt (top, center) (Courtesy of Mount Auburn Cemetery Historical Collections & Archives); [Death note of Jacques Burkhardt's passing](#) in the Springfield Daily Republican, the local journal in Springfield, Massachusetts (Courtesy of Anonymous 1867).

the Jamaica Plain neighborhood of Boston, Massachusetts (Anonymous 1867) (Fig. 3) and was buried at Mount Auburn Cemetery in Cambridge, Massachusetts (Mount Auburn Cemetery n.d.)⁶.

In the preface to Elizabeth and Louis Agassiz's 1867 chronicle of their adventures, *Journey in Brazil*, Agassiz grieved for his life-long friend, writing:

There is but one sad record I have to make connected with this journey. My friend and companion of many years, Mr. Burkhardt, died about ten months after his return, of a disease which, though not contracted in Brazil, since it was of some years' standing, was no doubt aggravated by the hot climate. His great desire to accompany me led him, against my advice, to undertake a journey which, in his case, was a dangerous one. He suffered very much during our stay on the Amazons, but I could not persuade him to leave his work; and in the following pages it will be seen that his industry was unflagging. (Agassiz and Agassiz 1867; p. VIII)

In Burkhardt's absence, Agassiz continued to work on his project with artist Paulus Roetter, a project ultimately stalled by setbacks. A cerebral hemorrhage in 1869 left Agassiz completely paralyzed and unable to speak, leading to a prolonged convalescence. In 1871 Agassiz joined the Hasler Expedition (1871–1872) deep-sea dredging operation to collect marine specimens. And ultimately, on December 14, 1873, Agassiz suffered a second cerebral hemorrhage and died (Lurie 1960).

With Burkhardt and then Agassiz's passing, Burkhardt's work became largely forgotten. The Brazilian fishes drawings were studied by ichthyologists, who duly published their results, but rarely were Burkhardt's illustrations reproduced. In January 1940, MCZ museum director Thomas Barbour delivered Burkhardt's Brazilian fishes drawings to ichthyologist and Stanford University professor George S. Myers with a letter stating, "[...] perhaps find some use for them. If not, I suppose even in California you occasionally have a fire in the grate" (Britski and de Figueiredo 2023; p. 27). By 1965, however, Myers himself realized the drawings last in his possession had vanished inexplicably (Britski and de Figueiredo 2023).

In response to several inquiries in the 1970s and 1980s by the MCZ to the scientific community concerning the missing drawings, they just as inexplicably reappeared packaged in a large box sent from an anonymous sender. All of the Brazilian fishes drawings were enclosed, untouched (Jonas 1994). Since that time, the MCZ has undertaken the digitization of the entire Jacques Burkhardt Scientific Drawings collection. More recently, Burkhardt's Brazilian fishes drawings were published for the first time in 2023 by Heraldo Antonio Britski and José Lima de Figueiredo in *Peixes do Brasil — Aquarelas de Jacques Burkhardt (1865–1866): Brazilian Fishes — Watercolors by Jacques Burkhardt (1865–1866)*.

JACQUES BURKHARDT SCIENTIFIC DRAWINGS COLLECTION

The Jacques Burkhardt Scientific Drawings collection in the Ernst Mayr Library of the Museum of Comparative Zoology (Harvard University) consists of 976 scientific drawings of turtles, fishes, lizards, and more (MCZ n.d.). Among the collection are 154 drawings of North American turtles. If our analysis is any indication of the overall scope of Burkhardt's work, the collection includes drawings of actual museum specimens that were part of the Museum of Comparative Zoology, Harvard University, collection.

The larger purpose behind Burkhardt's turtle drawings remains uncertain. Most likely, they were being prepared as part of Agassiz's ambitious ten-volume quarto series, *Contributions to the Natural History of the United States of America*, imagined at 300 pages each with 20 illustrated plates apiece that—after volume four—never fully came to fruition (Agassiz 1855, Agassiz 1885b).

As Agassiz's personal artist, Burkhardt's drawing skills became well honed. The testimony of Burkhardt's progression is evident in his choice of colors, the attention paid to detail like individual scutes and scales, and his understanding of shading, light and shadow, and reflections. As is the case with the Brazilian fishes drawings, the turtle drawings in the Burkhardt collection range from crude preliminary pencil drawings to detailed watercolors intermixed with half-pencil/half-water-



Fig. 4. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.10.a (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology).

color drawings that appear incomplete, and include detailed insets, anatomical sketches, partial views, and artistic studies.

Our review of the Jacques Burkhardt Scientific Drawings collection identified six Western Pond Turtle drawings. Among Burkhardt's turtle illustrations are two watercolor drawings clearly identified in Agassiz's handwriting as *Emys nigra*. Drawing bAg.168.60.10.23.a includes an annotation that reads, "*Emys nigra* Hall. South. California (Baird)" (see Fig. 12), while the annotation for drawing bAg.168.60.10.10.a reads, "To be compared with *Emys nigra* Hallowsell; from Lower California. This is from San Francisco" (Fig. 4). Four additional unlabeled drawings stood out as possible Western Pond Turtles (see Figs. 6, 7, 9, and 10) and look to be alternate views of the same turtle specimen.

To help establish possible connections between these drawings, we compared them with preserved Western Pond Turtle specimens in the MCZ in the hope that we might identify matches that would help determine whether any MCZ Western Pond Turtle specimens were the basis for Burkhardt's drawings. This link between drawings and specimens provides an additional layer of data associated with the accession

of each specimen; namely, their rough collection location (California) and their collector (Thomas Greaves Cary, Jr.).

There are 16 *Actinemys* specimens housed in the MCZ. Among those specimens are nine turtles that were collected prior to Burkhardt's death in 1867 by none other than Thomas Greaves Cary, Jr. (August 16, 1824 – December 28, 1888), the brother-in-law of Burkhardt's employer, Louis Agassiz.

Cary, Jr., it would appear, is purported to have been responsible for "a great many thousand fishes, reptiles, mollusks, crustacea, and echinoderms from San Francisco Bay, which he has collected himself during several successive years" (Agassiz 1861; p. 52). In the preface to his seminal work, *Contributions to the Natural History of the United States of America (Volume 1)*, Agassiz acknowledges Cary, Jr.'s contributions stating, "I have also received extensive collections, especially from California, through the kindness of [Mr.] Thomas G. Cary, Jr. ... of San Francisco, who [has] sent me beautiful series of specimens of the only fresh-water Turtle found on the western slope of the continent of North America" (Agassiz 1857a; p. XIV).

and Rough-Skinned Newt (*Taricha granulosa*) in September 1857 (A-173)—all reported from San Francisco. A single fish species, Coastal Roach (*Hesperoleucus venustus*) in September 1857 (Ich-1973), places Cary, Jr. at San Mateo Creek (San Mateo County) along the San Francisco Peninsula South of San Francisco.

With the exception of the fish, all of these lizard and newt specimens are unlikely to have been examples of commercially-harvested game species, which suggests they were most likely collected in the wild (rather than sourced from San Francisco's fish and game markets). Combined, the location in California where the ranges of these wildlife species overlap roughly coincides with the present-day greater San Francisco Bay Area, a region recognized today as the intergrade zone between Northwestern (*A. marmorata*) and Southwestern Pond Turtle (*A. pallida*) (Spinks et al. 2014, Shaffer and Scott 2022), suggesting that if Cary, Jr.'s turtle specimens were wild-caught, they would most likely be identified as *marmorata* today.

However, alongside the herpetological specimens described above, Cary, Jr. also collected several marine turtle, mollusk, and fish species that were likely sourced from San Francisco's markets, including Green Sea Turtle (*Chelonia mydas*) in 1856 (R-1402) and Giant Pacific Octopus (*Enteroctopus dofleini*) (Mala-243156) which, "In the markets of San Francisco it is often sold fresh, to the French and other foreigners, for food" (Vereill 1883; p. 120). This leaves open the possibility that any freshwater turtles may instead have been sourced when Cary, Jr., visited San Francisco's market stalls, whose stock of Western Pond Turtles came from terrapin fishermen throughout California and would have included a mix of *marmorata* and *pallida* (Bettelheim 2005, Bettelheim and Wong 2022).

We also cannot rule out that Cary, Jr. may have been a middle man between collectors and Louis Agassiz, further obfuscating the origin of specimens. In *Extraordinary Fishes from California, Constituting a New Family*, Agassiz describes his collaboration with A.C. Jackson, Esq. and Capt. Chase, U.S.N. on the procurement of a live-bearing surfperch (*Embiotoca jacksoni*) from San Salita (Sausalito) Bay, in which Jackson instructs Chase "to supply my friend T.G. Cary junr., Esq., of San Francisco, with specimens of that fish, should he succeed in getting any." Such specimens were eventually procured and preserved in alcohol, of which three were "sent by express" while "a larger supply was shipped round Cape Horn" to Agassiz (Agassiz 1853; p. 217).

Without more precise collection locations, all we can ascertain from the MCZ catalogues is that the specimens were obtained by Cary, Jr., in the greater San Francisco Bay Area and might therefore represent either *marmorata* or *pallida*.

SPOTS ILLUSTRATED

The Western Pond Turtle's markings are often described as highly variable depending on geography, ontogeny, and sex (Holland 1994, Bury et al. 2012). Baird and Girard (1852; p. 177) proposed the epithet *Emys marmorata* based simply on coloration, "yellowish brown marbled with black". Stebbins later described the carapace as "olive, brown, or blackish, occasionally without pattern but usually with a network of spots, lines, or dashes of brown or black that often radiate from growth centers of shields," and notes that "large old males from San Joaquin Valley, Calif. may be marked with large areas of beige and pinkish beige" (Stebbins 2003; p. 249-50) often described as a piebald appearance (Holland 1994).

California Academy of Sciences herpetologist John Van Denburgh more aptly describes the Western Pond Turtle's variability as follows:

The coloration is very variable. In some specimens the carapace is olive or horn-color with few or no markings. In others a few broken and very irregular black lines are present. These lines frequently have become so numerous that, blending and crossing, they appear as the ground color, or form a very fine network through which the original ground color shows more or less indistinctly. Sometimes the carapace is almost black. The plastron is yellow, usually irregularly blotched with black or brown, or with dark lines along the posterior margins of the plates. The upper surface of the head may be unicolor or finely or coarsely reticulated with yellow and black. The chin and throat are yellow, often dotted with brown or black. The limbs and tail are yellow marked with black or brown, or brown marked with yellow. In young, the plates of the carapace show a central area of brown sometimes surrounded by a band of lighter brown or dull yellow, and the markings on the limbs, tail, neck, and gular region form irregular longitudinal bands. (Van Denburgh 1897; p. 31)

In the wild, this can range from "lighter" turtles exhibiting a light base color and few to no dark markings to "darker" turtles exhibiting an overlapping network of broken or irregular dark lines overlaying a light base that presents as little to no speckling. Collectively, this intricate network of spots, lines, and dashes comprise the overall vermiculations, reticulations, and marbling that illustrate the turtle's variability. And it is this variability that Burkhardt—perhaps at Agassiz's insistence—appears to have been exploring across these six Western Pond Turtle drawings.

MODEL SPECIMENS

The basis for this study was inspired by the previous works of Bour (1986) and Bour and Schmidtler (2014).

From our review of the collection, it appears that Agassiz and Burkhardt were striving to capture these turtles' various morphotypes and tease out separate species among their specimens. Despite being a staunch opponent of Darwin's theory of evolution, Agassiz was often confounded by the individual variety exhibited by an individual organism vs their representative species. This struggle is perhaps best exemplified in his efforts to rectify the variety of toe-numbers among *Cistudo* spp. as he sought to distinguish, describe, and assign box turtles to individual species (Agassiz 1857a, Winsor 1979). Thus, these explorations exemplified in the collection and specifically the *Actinemys* spp. drawings may represent one of the first attempts at describing a "northern" and "southern" species based on the variability in markings observed across these species.

In these analyses that follow, we first present each Burkhardt drawing (or pair of drawings) unaltered, match them with their respective Western Pond Turtle specimen from the MCZ's collection, and provide an overall description for the three MCZ Western Pond Turtle specimens that we believe are the basis for five of Burkhardt's six *Actinemys* spp. drawings. Each analysis is accompanied by a composite image comparing dorsal, lateral, and ventral views.

We analyzed MCZ specimens by reviewing digital photographs of each specimen in a dorsal, ventral, and lateral view, plus close-up photographs of the inguinal region.⁹ The digital photographs included images of the specimens "wet" (immediately upon removal from their preservative) and "dry" to capture the full range of markings (e.g., vermiculations, reticulations, and marbling) and discolorations; scute seams; scute annuli; shell wear and damage; and other nuanced characteristics.

Descriptions are based primarily on shared physical traits, including but not limited to sex characteristics (Bury et al. 2012), prominent markings/patterns, carapace/plastron shape, individual scute shape, scute seams, and shell damage. Carapace and plastron scute nomenclature is consistent with Boulenger (1889) and Stebbins (2003) and musculature nomenclature with Noble and Noble (1940). Given that this species deposits one scute annulus per year up to 15–16 years of age (sometimes sooner) (Bury and Germano 1998, Germano and Bury 1998, Germano and Bury 2009), scute annuli were used for age estimates calculated only so far as the number of countable annuli.

Due to uncertainties such as whether the drawings were prepared from living or preserved specimens, or the degree to which the MCZ specimens may have deteriorated, faded, or

been damaged over time, comparisons of color were deemed a less reliable metric. In the place of color comparisons, focus was instead given to prominent markings (spots, lines, and dashes) and patterns (vermiculations, reticulations, and marbling), mottling, and shading.

We follow the most widely accepted nomenclature (Turtle Taxonomy Working Group 2025) for these species respectively: Northwestern Pond Turtle (*Actinemys marmorata*; Baird & Girard, 1852) across the northern part of the range, and Southwestern Pond Turtle (*Actinemys pallida*; Seeliger, 1945) across the southern part of their range.

To date, attempts to identify geometric morphometric data such as plastron shape that could be used to distinguish between these cryptic species have found no clear connection (see Burroughs et al. 2024). Our attribution to species is primarily based on the relative presence or absence of an inguinal scute, a diagnostic "rule of thumb" first described by Seeliger in 1945. In general, the Northwestern Pond Turtle (*Actinemys marmorata*) typically exhibits relatively large inguinal scutes (est. 89% of *marmorata*), while the Southwestern Pond Turtle (*Actinemys pallida*) typically exhibits reduced (est. 39% of *pallida*) or absent (est. 60% of *pallida*) inguinal scutes (Seeliger 1945, Stebbins 2003, Bury and Germano 2008). Because no quantitative metric has been quantified, we instead considered four qualitative size-classes: Absent (= *pallida*), Small (= *pallida*), Intermediate (= indeterminate), and Large (= *marmorata*). Secondly, *marmorata* males display a definite line of demarcation in background color contrasting the brown side and yellowish underside of the neck, while *pallida* males display a more uniform background color across the side and underside of the neck (Seeliger 1945, Stebbins 2003, Bury and Germano 2008). Turtles in the greater San Francisco Bay Area represent an area of admixing between the two species as a result of natural range boundaries and human-mediated introductions (Shaffer and Scott 2022).

Likewise, our determination of sex is based on the presence/absence of key sexually dimorphic traits. Mature males typically exhibit a light throat, pointed snout, concave plastron, and a thicker/longer tail whose cloaca is positioned posterior to the carapace edge. Mature females typically exhibit a speckled throat, blunt snout, more domed carapace, flat plastron, and a narrower/shorter tail whose cloaca is positioned anterior to the carapace edge. Because not every characteristic is readily visible, and no one characteristic is considered diagnostic, as many characteristics as possible were considered before assigning a sex determination (Bury et al. 2012).

Certain traits, like the positioning of the head, limbs, and tail, bear a shared resemblance between the drawings and specimen. However, these observations are only meaningful if the drawings were prepared based on a preserved (rather than

a living) specimen and whether the resting position of the specimen shifted during the preservation process or while being handled to be photographed. For example, specimens preserved in ethanol stored in a glass jar may sink to the bottom, compressing the tail and hind limbs upwards into the shell. For these reasons, the positioning of extremities was not formally considered during our analyses.

As a consequence of this analysis, we observed that in addition to the growing use of natural marks like plastron (Salom-Oliver 2022, Markle et al. 2022) and carapace (Gray 2008) color patterns and pigmentation, other discriminative features like certain scutes, scute seams, scute, and scute intersections or junctions (see Bender 2001, Gray 2008, Sedláč et al. 2017) may be unique enough in and of themselves in *Actinemys* spp. to serve as “fingerprints” or identifying marks that could assist with mark-recapture studies, photo-identification, or other comparative studies like this. This includes [1] the first vertebral (V1), [2] the intersection of V1 at M1/M2, [3] the intersection of M9 at C3/C4, and [4] the intersection of M11 at C4/V5¹⁰.

BURKHARDT'S TURTLES

Of the six Western Pond Turtle (*Actinemys* spp.) drawings we examined, we were successful in matching five of them with three MCZ specimens.

- R-1740 = bAg.168.60.10.10.j and bAg.168.60.10.5.f [see Description #1]
- R-1734 = bAg.168.60.10.9.c and bAg.168.60.10.9.d) [see Description #2]
- R-1733 = bAg.168.60.10.23.a [see Description #3]

All three specimens are young to mature adult males representing both *A. marmorata* (R-1740) and *A. pallida* (R-1734 and R-1733).

The remaining drawing, bAg.168.60.10.10.a (Fig. 4), does not appear to have a matching specimen in the MCZ collection. Our comparison of this specimen against the two de-accessioned MCZ specimens, University of Michigan specimen 5304 (= R-1738) and ZSM 17/1932 (= MCZ R-1741), was equally unsuccessful. This partial half-pencil/half-watercolor drawing of a turtle illustrated in a dorsal view is signed “Js Burkh” (the remainder of the signature is cut off) followed by the annotation, “To be compared with *Emys nigra* Hallowell; from Lower California. This is from San Francisco” in Agassiz’s handwriting. Unlike any other drawing in the collection, this sheet of paper¹¹ is torn, the surface marred with watermarks, the edges foxed.

We can only confidently determine that this individual turtle is a male *Actinemys* spp. based primarily on the thick-based longer tail. In comparison with the other drawings and il-

lustrations, this turtle’s markings might best be described as exemplifying a light base, with few to no dark marking radiating outward from each scute. This representation of a lighter-colored variant of the species’ markings helps further the argument that Agassiz and Burkhardt were striving to capture these turtles’ various morphotypes.

Altogether, the variability Burkhardt was able to capture in illustrating these turtles’ various morphotypes showcases not only the range of markings expressed across the Western Pond Turtle complex, but also Burkhardt’s accomplishment as an artist in his prime. From an inauspicious start painting window shade landscapes, Burkhardt’s time served alongside Agassiz as half-draftsman, half-“camera” came into its own at long last due in no small part to the thousands of fishes and other wildlife species he brought to life on paper. Forgotten and rediscovered, Burkhardt’s dozens of turtles—smaller though the collection may be—deserve no less recognition than his many hundreds of fishes. By revisiting the artist, and by reconnecting his drawings with the specimens that inspired them over 150 years ago, we offer a second life to a collection that once seemed destined to gather dust.

DESCRIPTION #1

EML Catalogue No.: [bAg.168.60.10.5.f](#) (Fig. 6)

Title: Turtle (top view) (1857)

Page Size: 13 x 23 cm

Drawing Size: 11 x 19 cm

Annotation (Annotator): “Js Burkhardt 1857” (Jacques Burkhardt)

Description: Watercolor drawing representing an unidentified turtle species illustrated in a dorsal view

EML Catalogue No.: [bAg.168.60.10.10.j](#) (Fig. 7)

Title: Turtle on grass (side view) (1857)

Page Size: 14 x 24 cm

Drawing Size: 7 x 20 cm

Annotation (Annotator): “Js Burkhardt 1857” (Jacques Burkhardt)

Description: Watercolor/pencil drawing representing an unidentified turtle species on grass illustrated in a lateral view

Associated MCZ Specimen No.: [R-1740](#) [Whole animal (ethanol)]

Identification: In comparing Burkhardt’s drawings (bAg.168.60.10.10.j and bAg.168.60.10.5.f) with R-1740 (see Fig. 8), we determine that this individual turtle is a male Northwestern Pond Turtle (*Actinemys marmorata*) based primarily on the large inguinal scute, pointed snout, pale chin, thick-based longer tail, position of the cloaca posterior to the carapace edge, shallow-domed carapace, and slight plastral indentation. A count of the growth annuli and straight cara-

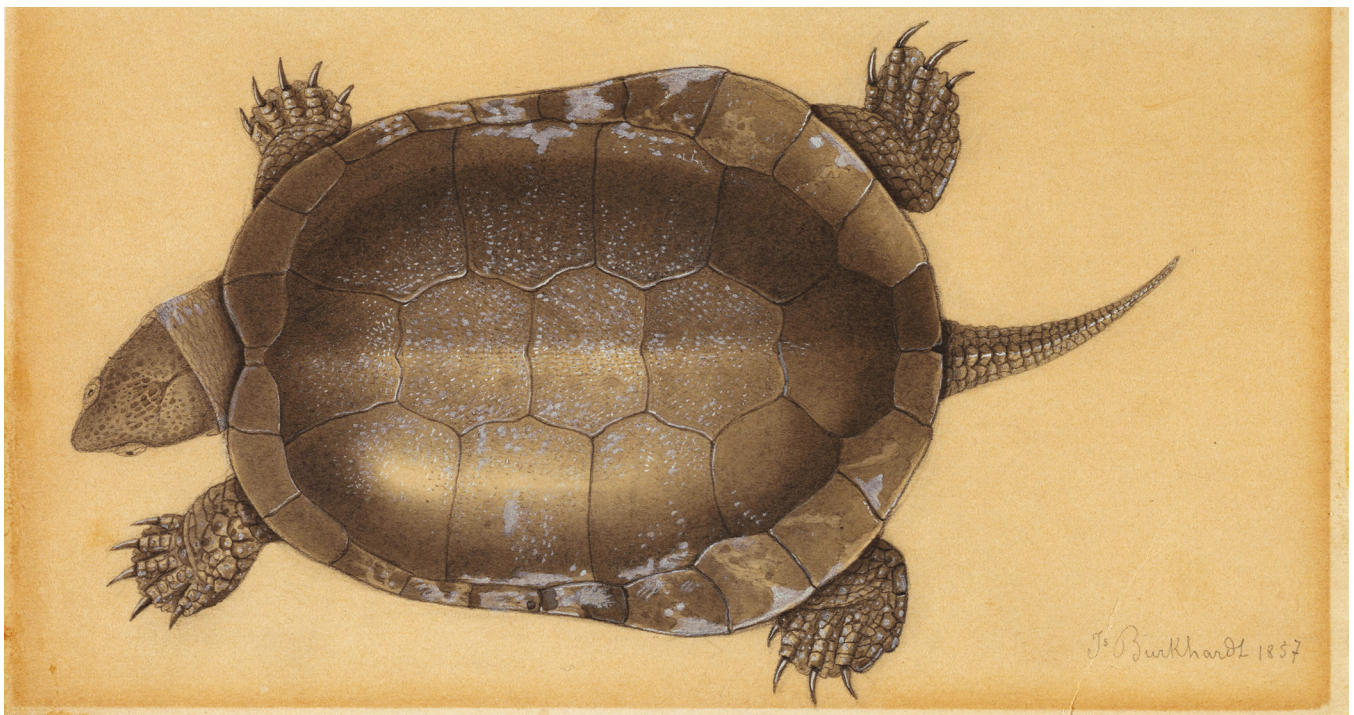


Fig. 6. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.5.f (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology).

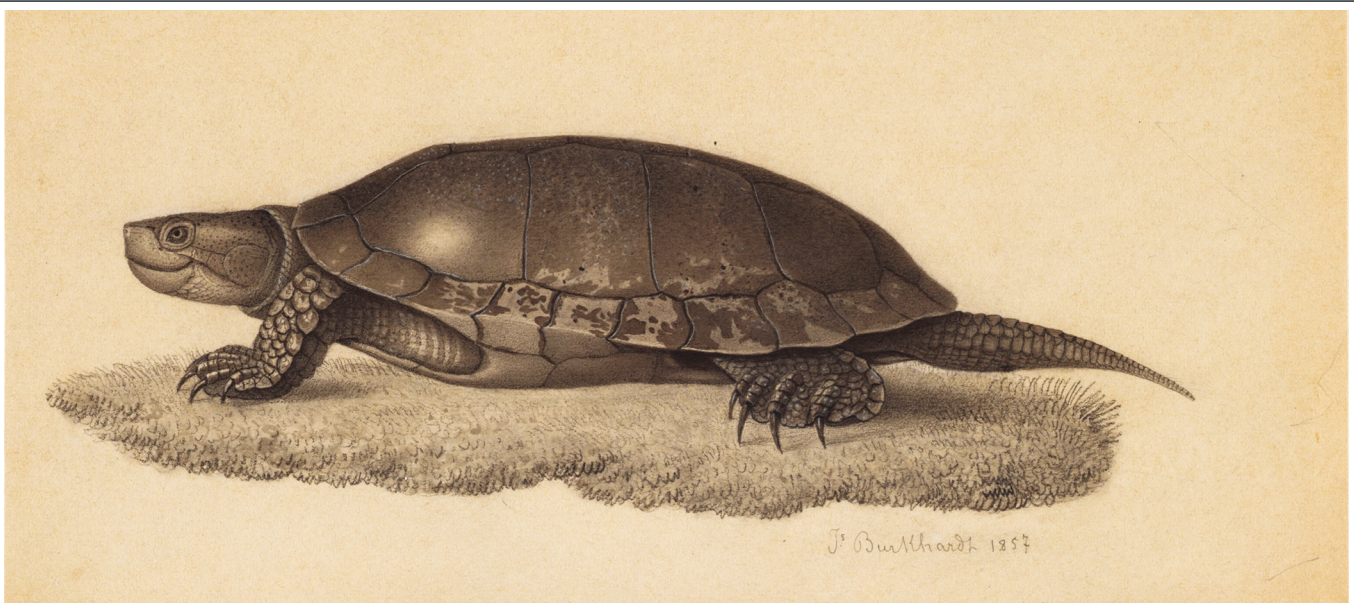


Fig. 7. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.10.j (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology)



Fig. 8. A composite image comparing Jacques Burkhardt scientific drawings EML catalogue no.'s bAg.168.60.10.10.j (bottom left) and bAg.168.60.10.5.f (top center) (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology) with photographs of MCZ specimen R-1740 in ventral (top left), dorsal (top right), and lateral (bottom right) views [Courtesy of Museum of Comparative Zoology, Harvard University; ©President and Fellows of Harvard College (<https://nrs.harvard.edu/urn-3:HUL.eother:idscopyright>)]. All images were trimmed for comparison purposes.

pace length (SCL) (~177 mm) together with the well-worn, mottled shell suggests a mature adult with an approximate minimum age well in excess of 8+ years.

Comparison: Key diagnostic characteristics that confirm the match between the drawings and specimen include the lateral shape of the carapace; identical pale speckled lines, notably C2(r) to C3(r) and C3(l); identical pale mottling, notably M4 to M11 and C2 to C3; “bow-tie” shape of N and M1; identical V1 scute configuration, notably at M1/M2; identical scute configuration, notably M9 at the C3/C4 and M11(l) at the C4/V5 intersections; identical C/C, V/V, and C/V seams; and off-set seam at the V4/V5 intersection (see Table 1).

DESCRIPTION #2

EML Catalogue No.: [bAg.168.60.10.9.c](#) (Fig. 9)

Title: Turtle on grass (side view) (1858)

Page Size: 16 x 26 cm

Drawing Size: 7 x 22 cm

Annotation (Annotator): “Js Burkhardt 1858” and “62” (Jacques Burkhardt)

Description: Watercolor/pencil drawing representing an unidentified turtle species on grass illustrated in a lateral view

EML Catalogue No.: [bAg.168.60.10.9.d](#) (Fig. 10)

Title: Turtle (bottom view) (1858)

Page Size: 11 x 17 cm

Drawing Size: 18 x 26 cm

Annotation (Annotator): “Js Burkhardt 1858” and “62” (Jacques Burkhardt)

Description: Watercolor/pencil drawing representing an unidentified turtle species illustrated in a ventral view

Associated MCZ Specimen No.: [R-1734](#) [Whole animal (ethanol)]

Identification: In comparing Burkhardt’s drawings (bAg.-168.60.10.9.c and bAg.168.60.10.9.d) with R-1734 (see Fig. 11), we determine that this individual turtle is a male Southwestern Pond Turtle (*Actinemys pallida*) based primarily on the small inguinal scute, pale chin, thick-based longer tail, position of the cloaca posterior to the carapace edge, shallow-domed carapace, and slight plastral indentation. A count of the growth annuli and SCL (~145 mm) suggests a young adult with an approximate minimum age of 7 to 10+ years. The shared “62” notation further establishes that bAg.168.60.10.9.c and bAg.168.60.10.9.d are associated and represent the same turtle.

Although the drawing lacks the small inguinal scutes present on the specimen, this oversight could easily be attributed to the concealed position of the inguinals and that the importance of this characteristic as a diagnostic trait was not documented until 1945 (Seeliger 1945).

Comparison: Key diagnostic characteristics that confirm the match between the drawings and specimen include three distinct post-ocular horizontal lines; lateral shape of the carapace; identical carapace speckling, notably M3 to M8 and C1 to C4; well-defined growth annuli (carapace/plastron); identical V1 scute configuration, notably at M1/M2; identical carapace scute configuration, notably M9(l) at the C3/C4 and M11(l) at the C4/V5 intersections; similar “bumps” at G/H and F/AN; overall light colored plastron with pronounced blotching along the interfemoral seam (P to F); identical dark blotching, notably P, AB, F, A, the P/AB seam, and the underside of the marginals; off-set seams at the AB/F intersection; and the outgrowth or knob on AB at either posterior edge of the bridge (see Table 2).

Table 1. Description of MCZ Specimen R-1740 and Drawings bAg.168.60.10.10.j and bAg.168.60.10.5.f.

HEAD AND NECK		
SHAPE	MARKINGS	
M. Pointed snout as seen in dorsal and ventral view (♂)	M. Similar speckling pattern M. Relatively pale chin in comparison to upper regions of head and neck (♂)	
M. Pronounced black maxillary line along the upper jaw		
M. Parietal temporal muscles visibly divided by a shallow depression		
LIMBS AND TAIL		
SHAPE	MARKINGS	
M. Cloaca posterior to carapace edge (spec.) (♂)	A.* Irregular discoloration and shading in the spec. compared to the typical “speckling” in the illus.	
M. Thick-based, longer tail (♂)		
A. Nail lengths vary on fore and hindlimbs from short (illus.) (♀) to long (spec.) (♂)		
CARAPACE		
SHAPE	MARKINGS	SCUTES/SCALES
M. Overall carapace shape (laterally): sloped <i>N</i> to <i>V1</i> ending in a “bump”, flat-topped <i>V2</i> , rounded <i>V3</i> to <i>V5</i>	M. Overlapping network of broken or irregular dark lines, light base presents as little to no speckling	M. “Bow-tie” shape of <i>N</i> and <i>M1</i>
M. Carapace exteriorly pear-shaped, pronounced flare at <i>M7</i> , widest at <i>M8</i>	M. Identical pale speckled lines, notably <i>C2(r)</i> to <i>C3(r)</i> and <i>C3(l)</i>	M. Identical <i>V1</i> scute configuration, notably <i>M9</i> at the <i>C3/C4</i> and <i>M11(l)</i> at the <i>C4/V5</i> intersections
M. Shallow-domed (♂)	M. Identical pale mottling, notably <i>M4</i> to <i>M11</i> and <i>C2</i> to <i>C3</i>	M. Identical <i>C/C</i> , <i>V/V</i> , and <i>C/V</i> seams
?. SCL = 177 mm	M. No apparent growth annuli	M. Off-set seam at the <i>V4/V5</i> intersection
A. Nuchal length varies from short (illus.) to long (spec.)		
A.* Distal damage to spec. <i>SC</i> absent in illus.		
PLASTRON [no ventral illus.]		
SHAPE	MARKINGS	SCUTES/SCALES
M. Plastral indentation slight (♂)	?. Well-worn growth annuli; age est. 8+ yrs minimum	M. Identical seams/ intersections demarcating the bridge and carapace
?. Large inguinals (spec.) [= <i>marmorata</i>]		

"M." = match, "A." = anomaly, "♀" = female, "♂" = male, "spec." = specimen, "illus." = illustration, "G" = gular, "H" = humoral, "P" = pectoral, "AB" = abdominal, "F" = femoral, "AN" = anal, "N" = nuchal, "V" = vertebral [1 (*front*) to 5 (*back*)], "C" = costal [1 (*front*) to 4 (*back*)], "M" = marginal [1 (*front*) to 12 (*back*)], "SC" = supercaudal, "l" = left, "r" = right, "P" = right, "P" = right, "SCL" = straight carapace length; observations of limited use are denoted with an asterisk (*)

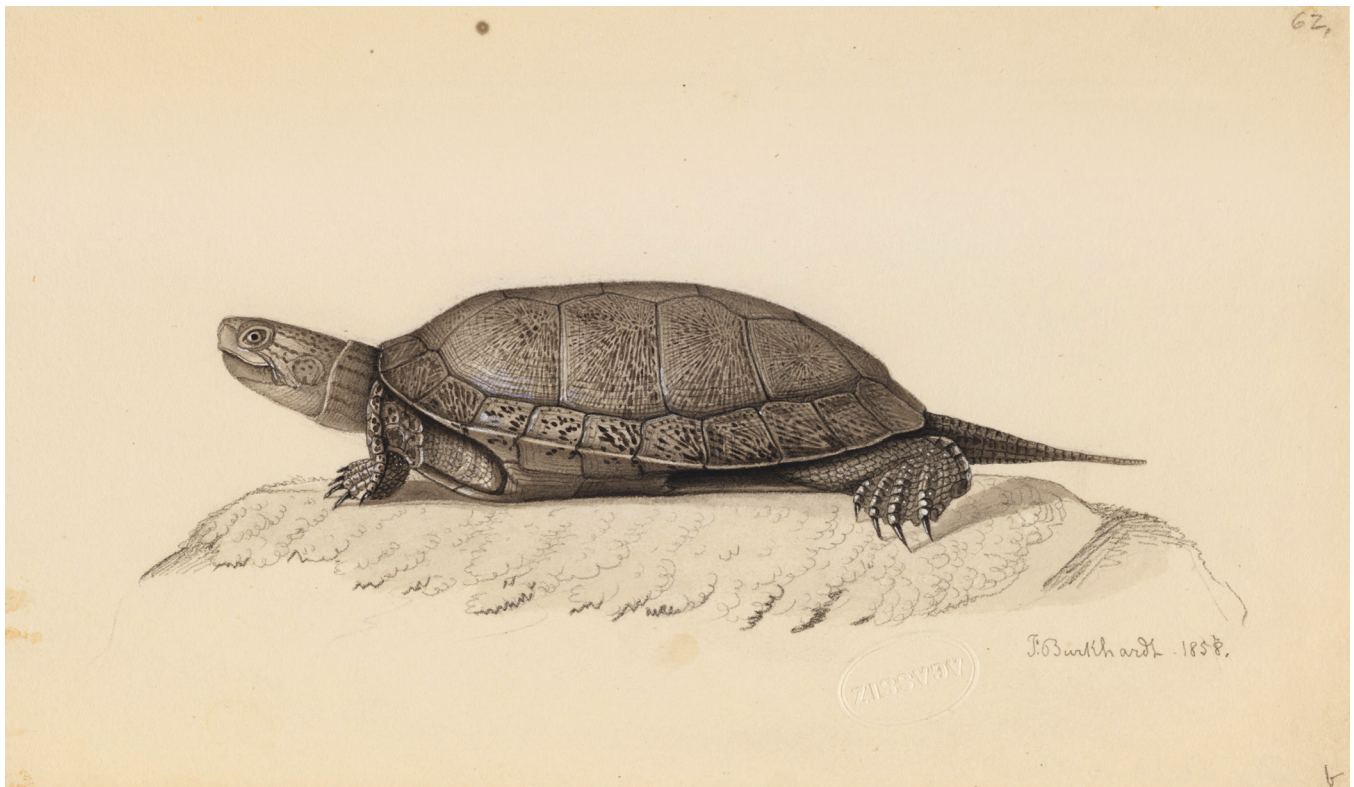


Fig. 9. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.9.c (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology)

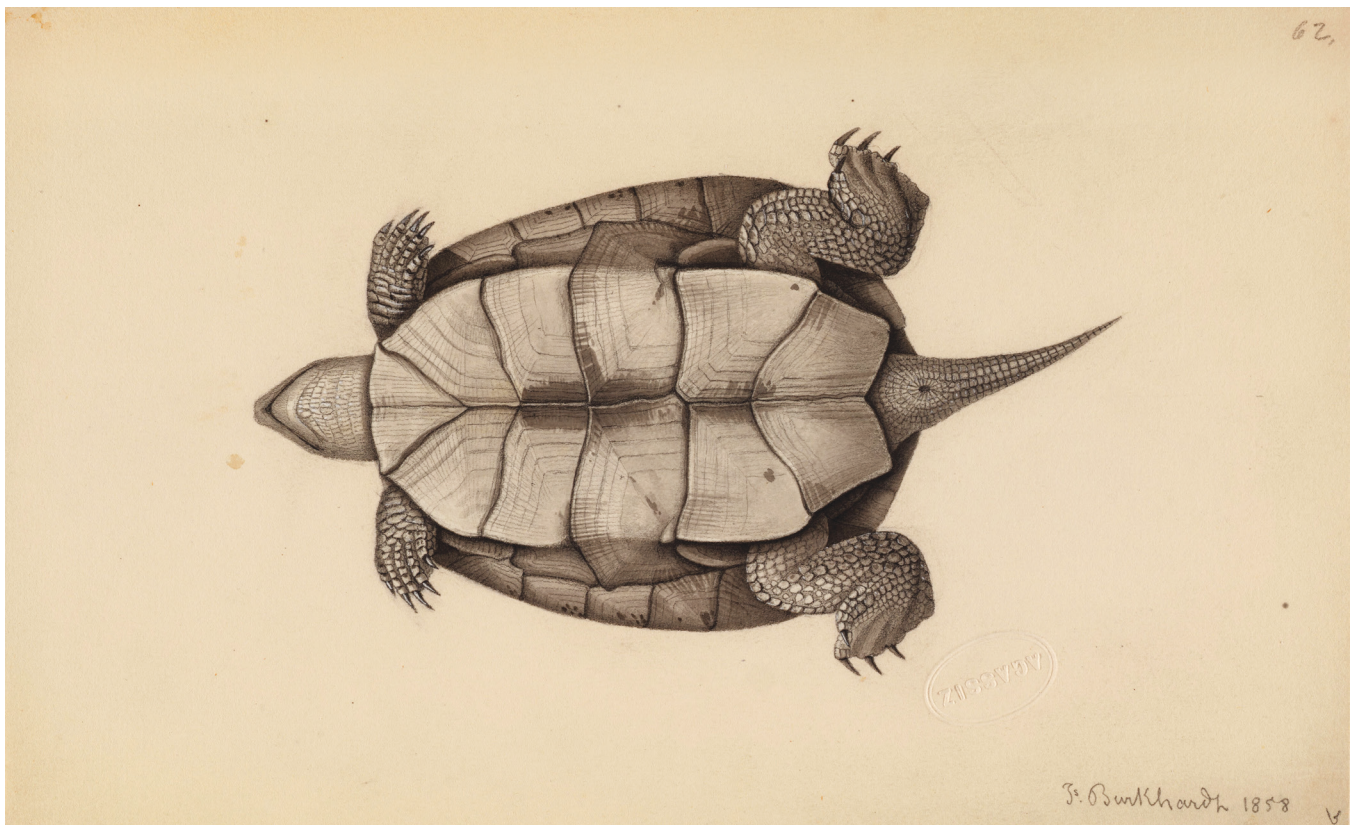


Fig. 10. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.9.d (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology)

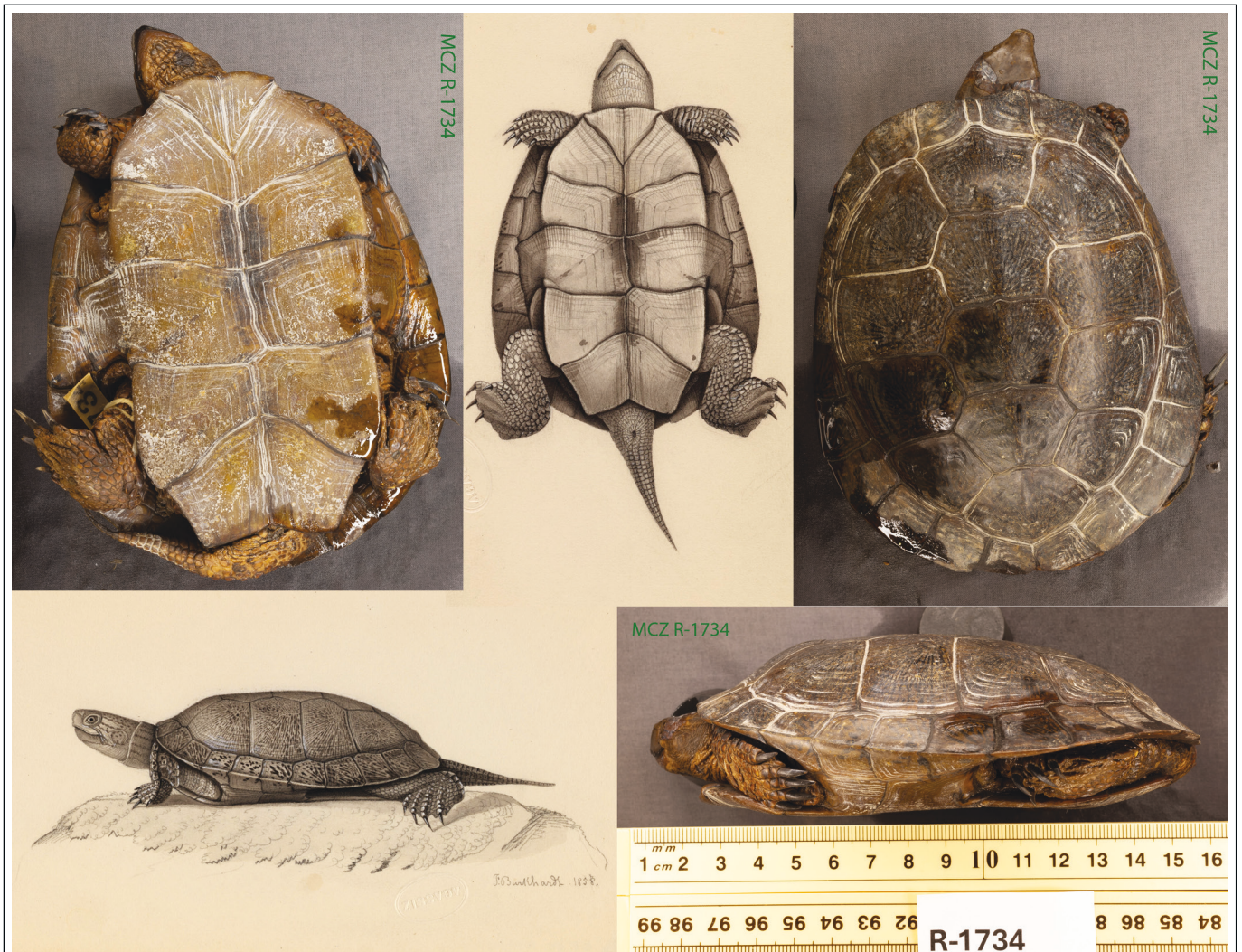


Fig. 11. A composite image comparing Jacques Burkhardt scientific drawings EML catalogue no.'s bAg.168.60.10.9.c (bottom left) and bAg.168.60.10.9.d (top center) (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology) with photographs of MCZ specimen R-1734 in ventral (top left), dorsal (top right), and lateral (bottom right) views [Courtesy of Museum of Comparative Zoology, Harvard University; ©President and Fellows of Harvard College (<https://nrs.harvard.edu/urn-3:HUL.eother:idscopyright>)]. All images were trimmed for comparison purposes.

Table 2. Description of MCZ Specimen R-1734 and Drawings bAg.168.60.10.9.c and bAg.168.60.10.9.d.

HEAD AND NECK	
SHAPE	MARKINGS
M. Blunt snout as seen in dorsal and ventral view (♀) M. Pronounced black maxillary line along the upper jaw	M. Three distinct post-ocular horizontal lines M. Relatively pale chin in comparison to upper regions of head and neck (♂) M. Identical scalation on the underside of the chin A.* Irregular discoloration and shading in the spec. compared to the typical “speckling” in the illus.
LIMBS AND TAIL	
SHAPE	MARKINGS
M. Cloaca posterior to carapace edge (♂) M. Thick-based, longer tail (♂) A. Nail lengths vary on fore and hindlimbs from short (illus.) (♀) to long (spec.) (♂)	A.* Irregular discoloration and shading in the spec. compared to the typical “speckling” in the illus.
CARAPACE [no dorsal illus.]	
SHAPE	MARKINGS
M. Overall carapace shape (laterally): sloped <i>N</i> to <i>V1</i> , flat-topped <i>V2</i> to <i>V3</i> , rounded <i>V4</i> to <i>V5</i> M. Carapace exteriorly teardrop-shaped, widest at <i>M8/M9</i> M. Shallow-domed (♂) ?. SCL = 145 mm	M. Light base, fine network of broken or irregular dark lines radiating outward from each scute M. Identical speckling, notably <i>M3</i> to <i>M8</i> and <i>C1</i> to <i>C4</i> M. Well-defined growth annuli; age est. 7-10+ yrs
SCUTES/SCALE	
M. Well-defined seams M. Identical <i>V1</i> scute configuration, notably at <i>M1/M2</i> M. Identical scute configuration, notably <i>M9(l)</i> at the <i>C3/C4</i> and <i>M11(l)</i> at the <i>C4/V5</i> intersections M. Identical <i>C/C</i> , <i>V/V</i> , and <i>C/V</i> seams M. Gradual exterior serration or scalloping along <i>M10</i> , <i>M11</i>	
PLASTRON	
SHAPE	MARKINGS
M. Overall plastron shape: gradual <i>G</i> , rounded <i>H</i> , boxy from <i>P</i> to <i>F</i> , tapered <i>AN</i> M. Similar “bumps” at <i>G/H</i> and <i>F/AN</i> M. Plastral indentation slight (♂)	M. Overall light colored plastron with pronounced blotching along the interfemoral seam (<i>P</i> to <i>F</i>) M. Identical dark blotching, notably <i>P</i> , <i>AB</i> , <i>F</i> , <i>A</i> , the <i>P/AB</i> seam, and the under-marginals M. Well-defined growth annuli; age est. 7-10+ yrs minimum
SCUTES/SCALES	
M. Well-defined seams M. Identical scute configuration, notably <i>AB(r)</i> and <i>F(l)</i> M. Off-set seams at the <i>AB/F</i> intersection M. Outgrowth or knob on <i>AB</i> at either posterior edge of the bridge M. Identical seams/intersections demarcating the bridge and carapace A. Irregular tapering of the anal scutes reversed between illus. and spec. A. Small inguinals on the spec. [= <i>pallida</i>] absent from illus.	

“M.” = match, “A.” = anomaly, “?” = no comparison available, “♀” = female, “♂” = male, “spec.” = specimen, “illus.” = illustration, “G” = gular, “H” = humoral, “P” = pectoral, “AB” = abdominal, “F” = femoral, “AN” = anal, “N” = nuchal, “V” = vertebral [1 (*front*) to 5 (*back*)], “C” = costal [1 (*front*) to 4 (*back*)], “M” = marginal [1 (*front*) to 12 (*back*)], “SC” = supercaudal, “l” = left, “r” = right, “P” = seam; “SCL” = straight carapace length; observations of limited use are denoted with an asterisk (*)

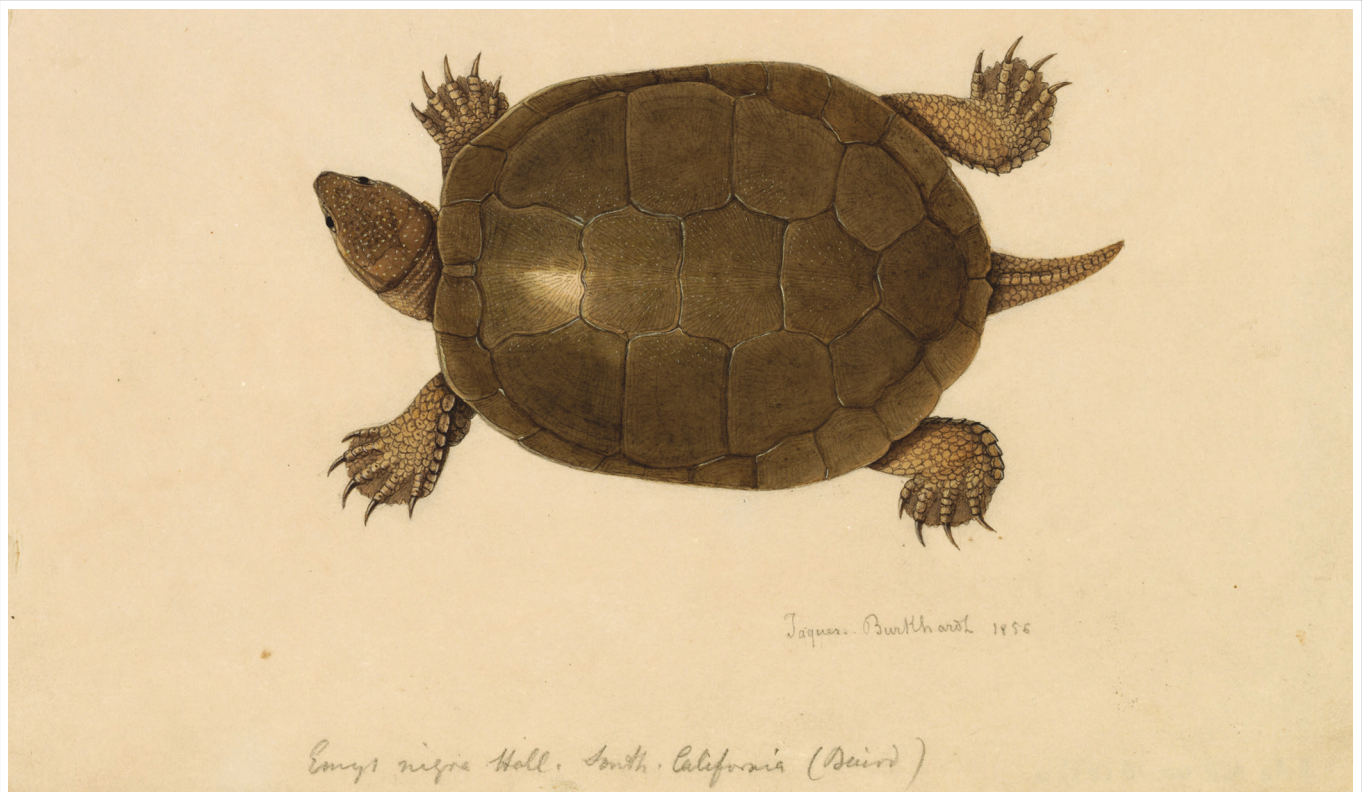


Fig. 12. Jacques Burkhardt scientific drawing, EML catalogue no. bAg.168.60.10.23.a (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology).

DESCRIPTION #3

EML Catalogue No.: [bAg.168.60.10.23.a](#) (Fig. 12)

Title: *Emys nigra* Hall (top view) (Southern California, 1856)

Page Size: 19 x 26 cm

Drawing Size: 10 x 15 cm

Annotation (Annotator): "Js Burkhardt 1856" (Jacques Burkhardt) and "*Emys nigra* Hall. South. California (Baird)" (Louis Agassiz)

Description: Watercolor drawing representing a turtle identified as *Emys nigra* from southern California illustrated in a dorsal view

Associated MCZ Specimen No.: [R-1733](#) [Whole animal (ethanol)]

Identification: In comparing Burkhardt's drawing (bAg.168.60.10.23.a) with R-1733 (see Fig. 13), we determine that this individual turtle is a male Southwestern Pond Turtle (*Actinemys pallida*) based primarily on the small inguinal scute, pointed snout, pale chin, thick-based longer tail, position of the cloaca posterior to the carapace edge, shallow-domed carapace, and slight plastral indentation. A count of the growth annuli and SCL (~156 mm) suggests a young adult with an approximate minimum age of 9+ years.

Comparison: Key diagnostic characteristics that confirm the match between the drawing and specimen include the exteriorly boxy-to-pear-shaped carapace; straight-line (or slightly compressed) appearance of M6 to M8; similar V1 scute configuration, notably at M1/M2; similar scute configuration, notably M9 at the C3/C4 and M11 at the C4/V5 intersections; and off-set seam at the V4/V5 intersection (see Table 3).

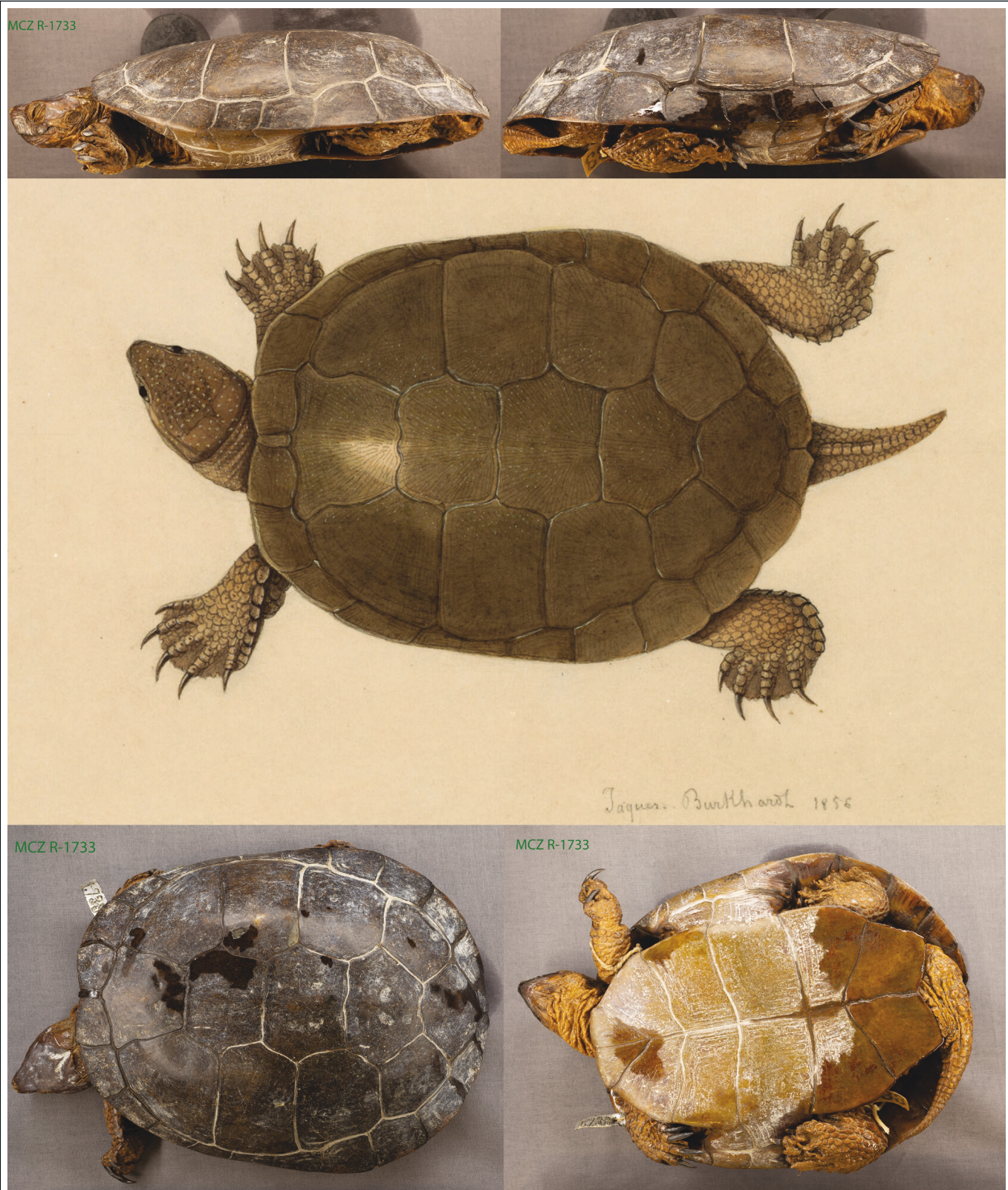


Fig. 13. A composite image comparing Jacques Burkhardt scientific drawings EML catalogue no. bAg.168.60.10.23.a (center) (Courtesy of Harvard University, Ernst Mayr Library of the Museum of Comparative Zoology) with photographs of MCZ specimen R-1733 in ventral (bottom right), dorsal (bottom left), and lateral (bottom left/right) views [Courtesy of Museum of Comparative Zoology, Harvard University; ©President and Fellows of Harvard College (<https://hrs.harvard.edu/urn-3:HUL.eother:idscopyright>)]. All images were trimmed for comparison purposes.

Table 3. Description of MCZ Specimen R-1733 and Drawing bAg.168.60.10.23.a

HEAD AND NECK		
SHAPE		SHAPE
M. Pointed snout as seen in dorsal and ventral view (♂)		M. Similar speckling pattern
M. Parietal temporal muscles visibly divided by a shallow depression		?. Relatively pale chin in comparison to upper regions of head and neck (♂)
LIMBS AND TAIL		
SHAPE		SHAPE
M. Cloaca posterior to carapace edge (spec.) (♂)		M. General pale appearance of skin with slight speckling
M. Thick-based, longer tail (♂)		
A. Nail lengths vary on fore and hindlimbs from short (illus.) (♀) to long (spec.) (♂)		
CARAPACE		
SHAPE	MARKINGS	SCUTES/SCALES
M. Carapace exteriorly boxy-to-pear-shaped, widest at <i>M8</i>	M. Light base, fine network of broken or irregular dark lines radiating outward from each scute	M. Similar <i>V1</i> scute configuration, notably at <i>M1/M2</i>
M. Distal straight-line (or slightly compressed) appearance of <i>M6</i> to <i>M8</i>	M. No apparent growth annuli	M. Similar scute configuration, notably <i>M9</i> at the <i>C3/C4</i> and <i>M11</i> at the <i>C4/V5</i> intersections
?. Shallow-domed (♂)		M. Similar <i>C/C</i> , <i>V/V</i> , and <i>C/V</i> seams
?. SCL = 156 mm		M. Off-set seam at the <i>V4/V5</i> intersection
		M. Minor serration of <i>M9</i> to <i>M11</i>
		A. <i>C/M</i> seams either exaggerated (illus.) or gradual (spec.)
		A. <i>C1(r)/V4</i> seam either straight (spec.) or curved (illus.)
		A. * Shape of <i>N</i> and <i>M1</i> either "bow-tied" (spec.) or boxy (illus.)
PLASTRON [no ventral illus.]		
SHAPE	MARKINGS	SCUTES/SCALES
?. Plastral indentation slight (♂)	M. Worn growth annuli; age est. 9+ yrs minimum	?. Small inguinals (spec.) [= <i>pallida</i>]

"M." = match, "A." = anomaly, "♀" = no comparison available, "♂" = female, "♂" = male, "spec." = specimen, "illus." = illustration, "G" = gular, "H" = humoral, "P" = pectoral, "AB" = abdominal, "F" = femoral, "AN" = anal, "N" = nuchal, "P" = vertebral [1 (front) to 5 (back)], "C" = costal [1 (front) to 4 (back)], "M" = marginal [1 (front) to 12 (back)], "SC" = supercaudal, "l" = left, "r" = right, "P" = right, "P" = right, "SCL" = seam; "SCL" = straight carapace length; observations of limited use are denoted with an asterisk (*)

ACKNOWLEDGEMENTS

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NOTES

1. Birth/death dates verified by Mount Auburn Cemetery, pers. comm., January 29, 2026
2. Sometimes misreported as "August" Sonrel.
3. *North American Starfishes*, the planned fifth volume of the *Contributions to the Natural History of the United States of America*, was published posthumously in 1877 by the Museum of Comparative Zoology (Agassiz 1877).
4. sitio = a small farm
5. Burkhardt's Itinerary: "4 February arrive at Par  . It must have been around this time that Burkhardt left the expedition due to illness to return to Boston; Agassiz's Journey in Brazil makes no mention of his departure, but Theodore Lyman recorded seeing him 9 March in Cambridge" (Manthorne 1989; p. 178).
6. "J. Burkhardt" grave site: Mount Auburn Cemetery, Cambridge, MA, USA, Spelman Road, Lot 3730, Site 8, Grave 1.
7. The MCZ catalogue identifies "Thomas G. Cary, Jr." as the preferred name for Thomas Greaves Cary Jr., but lists "Cary, T. G." and "T. G. Cary" as acceptable synonyms.
8. Signature Dates: 1856 (bAg.168.60.10.23.a), 1857 (bAg.168.60.-10.10.j and bAg.168.60.10.5.f), and 1858 (bAg.168.60.10.9.c and bAg.168.60.10.9.d)
9. All digital images prepared on behalf of this study are now publicly available in the MCZ digital collections catalogue for review.
10. "V" = vertebral [1 (front) to 5 (back)], "C" = costal [1 (front) to 4 (back)], "M" = marginal [1 (front) to 12 (back)], "f" = seam
11. Page size: 24 x 30 cm, drawing Size: 15 x 25 cm

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